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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 10/736,859 | 12/16/2003 | Jie Yao | 78227CIP1 P1510USCIP | 5386 |

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| EXAMINER | |
|---|---|
| DINH, THU HUONG T | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2812 | |

DATE MAILED: 09/01/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/736,859 | YAO, JIE | |
| | Examiner | Art Unit | |
| | Thu-Huong Dinh | 2812 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *16 December 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *19-29* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) *19,22,24-26* is/are rejected.

7)☒ Claim(s) *20-21,23,24,26-29* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *16 December 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

WALTER LINDSAY JR.
PRIMARY EXAMINER

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *1/20/2004*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 19 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohba et al. (U.S. 6242764 B1 dated June 5, 2001) in view of Gutierrez-Aitken et al. (U.S. 6566724 B1 dated May 20, 2003).

3. Ohba et al. teaches the following: (a) an intrinsic semiconductor layer (103) having a thickness ti of 5um, a doping concentration below 5e14 cm-3 and producing (column 6, lines 16-18), (b) an n-type contact layer (107) having a thickness of 1 um (column 6, lines 19-20) and p-type layer (114) (column 6, lines 28-29) having a thickness of 0.5 um and doped concentration dc1 between 1e17 and 2e18 cm-3 (column 6, lines 19-20), and wherein td1/ti is greater than or equal to 0.17 (column 6, line 20 and 28); by means of a first electrode (109) electrically coupled to said first light absorption doped semiconductor layer (column 6, lines 19-22), and a second electrode (114) electrically coupled to said light absorption intrinsic semiconductor layer (column 6, lines 16-28) (claim 19).

Ohba et al. lacks the anticipation of explicitly teaching the following: (a)...in response to light absorbed by said light-absorption intrinsic semiconductor layer, electrical carriers that are transported therethrough; (b)... said first light absorption

doped semiconductor layer having a first surface thereof abutting a first surface of said light absorption intrinsic semiconductor layer, and producing, in response to light absorbed by said first light absorption doped semiconductor layer, electrical carriers that are transported therethrough ; and (c) extracting electrical current comprised of said carriers produced by and transported through said light-absorption intrinsic semiconductor layer and said first light absorption doped semiconductor layer (claim 19).

Gutierrez-Aitken et al. teaches Low Dark Current Photodiode. This invention reducing the dark current in a photodiode that is compatible with the Heterojunction Bipolar Transistor (HBT) production process thus will improve the characteristic of the devices such as electrical leakage, doping diffusion and ohmic contact degradation. Gutierrez-Aitken et al. teaches a pin photodiode (100) includes the n-layer (120) which is grown on top of the substrate (110) is particularly well-suited for the absorption of 1.3-1.55 um wavelength light (column 3, lines 2-6). The i-layer (130) n-material which is grown on top of the n-layer (120) material (column 3, lines 15-16), the p-layer (140) p-material is grown on top of the i-layer (130) (column 3,lines 19-20). The movement of electrons from the valence band to the conduction band enables the flow of electrical current between the n-layer (120) n+ material and the p-layer (140) p+ material through the i-layer (130) n-material (column 3, lines 29-33).

Regarding claim 22, Ohba et al. in view of Gutierriez-Aitken et al. does not disclose the limitation the total thickness td1 + ti of said first light aborption doped semiconductor layer and said light absorption intrinsic semiconductor layer is greater

than v/(2f3-db) by 20% or more, where v is the saturation drift velocity of either the electron of the hole, whichever is smaller, in the intrinsic light-absorbing layer". However, the total thickness of the doped and intrinsic light absorption layers are result effective variables that one of ordinary skill in the art would optimize for emitting light. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have the total thickness of the doped and intrinsic light absorption layers is greater than v/(2B-db) by 20% or more, where v is the saturation drift velocity of either the electron of the hole, whichever is smaller, in the intrinsic light-absorbing layer, in order to maximize the amount of light emitted since it has been held that discovering the optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F. 2d 272, 205 USPQ 215 (CCPA 1980).

It would be obvious to one of ordinary skill in the art, at the time the invention was made, to modify the structure shown in Ohba et al. with the Gutierrez-Aitken et al. teaching of reducing dark current in a photodiode comprises building a barrier layer into the structure of a photodiode with the motivation of improving the characteristic of the devices such as electrical leakage, doping diffusion and ohmic contact degradation.

4. Claims 24-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohba et al. (U.S. 6242764 B1 dated June 5, 2001) in view of Gutierrez-Aitken et al. (U.S. 6566724 B1 dated May 20, 2003) as applied to claim 19 above, and further in view of Wake (U.S. 5949564 dated September 7, 1999).

Ohba et al. and Gutierrez-Aitken et al. shows the structure substantially as claimed and as described in the preceding paragraphs. In addition, Ohba et al. and

Gutierrez-Aitken et al. teaches: 1)... the i-layer (130) material, may comprise InGaAs doped lightly negative and lattice-matched to InP (column 3, lines 15-18) and the total thickness (td1 + ti) of said first light absorption doped semiconductor layer and said light absorption intrinsic semiconductor layer is greater than 0.60 microns (column 6, lines 18,21 and 28) (claim 24); 2)... absorption intrinsic semiconductor layer is greater than 0.65 microns (column 6, lines 18,21 and 28) (claim 25); 3)... absorption intrinsic semiconductor layer is greater than 0.70 microns (column 6, lines 18,21 and 28) (claim 26).

However, Ohba et al. and Gutierrez-Aitken et al. lack the anticipation of explicitly teaching the following: 1)...wherein, at a 3-dB bandwidth frequency of 40GHz or higher, (claims 24-26).

Wake teaches Transducer suitable for use in a hybrid optical and radio communication system. The transducer comprises of a contact layer provide to facilitate ohmic contact to the photodiode since any contact potential will obstruct current flow. With reference to Figure 2, the photodiode (2) comprises an InGaAs absorber layer (6) and a thickness of 0.13 microns (column 4, lines 25-27) grown on a sulfur-doped InP substrate (7) (column 4, lines 27-28) and 4 microns thick dielectric layer (8) is used to reduce bond-pad capacitance (column 4, lines 29-31). The photodiode (2) is then mounted on a package incorporating a Wilton K-connector to allow characterization up to a frequency of 40 GHz (column 4, lines 37-40).

It would be obvious to one of ordinary skill in the art, at the time the invention was made, to modify the structure shown in Ohba et al. with the Gutierrez-Aitken et al.

teaching with Wake's method of forming a transducer comprising a zero-bias edge coupled high speed photodiode with the motivation of operating with no electrical power supply, i.e. in remotely sited equipment are severe for terms of cost, size, weigh, frequency stability and power assumption.

***Claim Objections***

5. Claim 24, 26 are objected to because of the following informalities: "at a 3-dB bandwidth frequency of 40 DHz or higher", should be changed to " at a 3-dB bandwidth frequency of 40 GHz or higher". Appropriate correction is required.

***Allowable Subject Matter***

6. Claims 20-21, 23, 27-29 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

7. The following is a statement of reasons for the indication of allowable subject matter: the prior art, either singly or in combination fails to anticipate or render obvious, the limitations of:

> ... second light absorption doped semiconductor layer having a first surface thereof abutting a second surface of said light absorption intrinsic semiconductor layer that is spaced apart from said first surface of said light absorption intrinsic semiconductor layer by material of said light absorption intrinsic semiconductor layer therebetween, and producing: in response to light absorbed by said second light absorption doped semiconductor layer, electrical carriers that are transported therethrough,...(claim 20).

***Conclusion***

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Matsuda (U.S. 6,395,577 B1 dated May 28, 2002) teaches Photodetecting Device and Method of Manufacturing the Same. Giboney (U.S. 6,740,908 B1 dated May 25, 2004) teaches Extended Drift Heterostructure Photodiode Having Enhanced Electron Response. Kusakabe (U.S. 6020620 date February 1, 2000) teaches Semiconductor Light-Receiving Device with Inclined Multilayer Structure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thu-Huong Dinh whose telephone number is 571 272-9014. The examiner can normally be reached on Monday through Friday (8:30AM-5:00PM Eastern).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Lebentritt can be reached on 571 272-1873. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

thd

WALTER LINDSAY JR.
PRIMARY EXAMINER